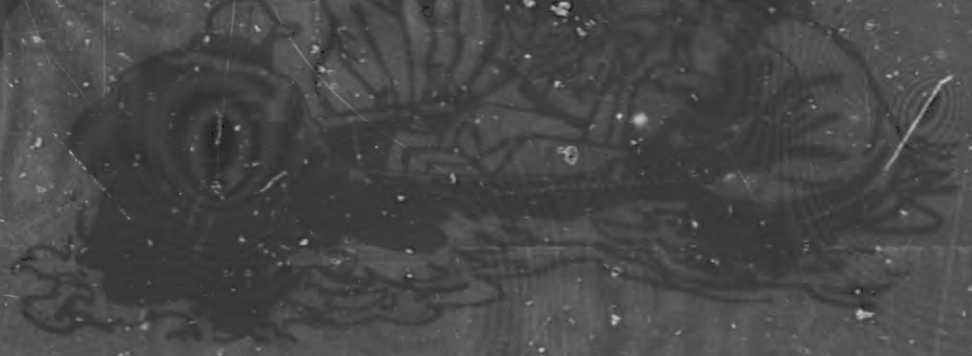
FLOOD INSURANCE STUDY



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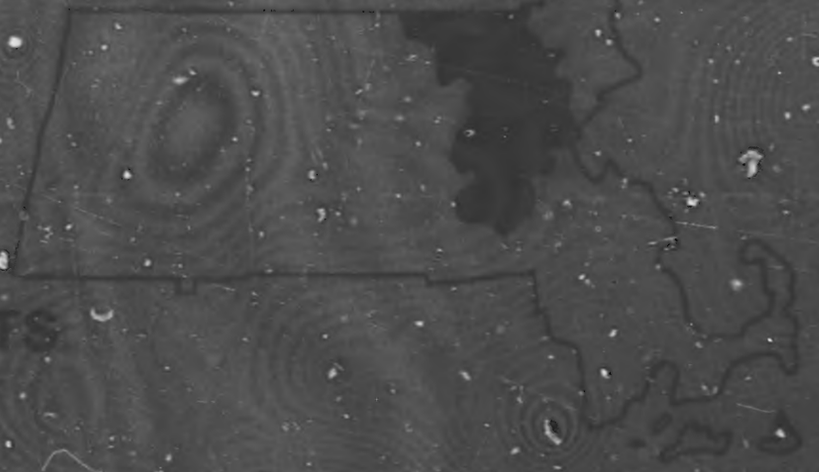

CITY OF MELROSE, MASSACHUSETTS
MIDDLESEX COUNTY

AUGUST 5, 1980

Federal Emergency Management Agency

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FLOOD INSURANCE STUDY
CITY OF MELROSE, MASSACHUSETTS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Melrose, Middlesex County, Massachusetts, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Camp Dresser and McKee Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. EMW-84-C-1601. This work was completed in March 1985.

1.3 Coordination

In April 1984, streams requiring detailed study were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA, the City of Melrose, and Camp Dresser and McKee Inc. (the study contractor). Results of the hydrologic analyses were coordinated with the U. S. Geological Survey (USGS), the U. S. Army Corps of Engineers (COE), and the Metropolitan District Commission (MDC). On September 12, 1985, the results of the study were reviewed at a final CCO meeting held with representatives of FEMA, the city, and the study contractor.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Melrose, Middlesex County, Massachusetts. The area of study is shown on the Vicinity Map (Figure 1).

Lower Spot Pond Brook from the downstream corporate limits to the outlet of Spot Pond Brook Branch and Ell Pond Brook Branch near Wyoming Station was studied by detailed methods. Flooding along the entire shoreline of Ell Pond within the city was also studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through March 1990.

Long Pond, Towners Pond, Swains Pond, Bennetts Pond, and several unnamed areas within the community were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Melrose.

2.2 Community Description

The City of Melrose is located in the southeastern portion of Middlesex County in eastern Massachusetts, approximately 7 miles north of the City of Boston. It is bordered by the Town of Stoneham to the west, the Town of Wakefield to the north, the Town of Saugus to the east, and the City of Malden to the south. According to the U. S. Bureau of the Census, the population of Melrose fell from 33,180 in 1970 to 30,055 in 1980, a 9.4-percent decrease (Reference 1).

Lower Spot Pond Brook (also called "The Big Ditch" since channel improvements were completed in 1960) is a trapezoidal concrete lined open channel that originates at the outlet of Spot Pond Brook Branch and Ell Pond Brook Branch near Wyoming Station, then flows south to the Melrose-Malden border. Eventually, the channel flows are discharged into a 12.5-foot diameter inverted siphon near Winter Street in Malden. The siphon is a tunnel that passes under Malden, then outlets into the Malden River near Charles Street in Malden. Tributaries to Lower Spot Pond Brook are Spot Pond Brook Branch and Ell Pond Brook Branch. These branches merge in an enclosed conduit that discharges at the head of Lower Spot Pond Brook near Wyoming Station. Ell Pond Brook Branch is enclosed in a conduit along its entire length. The total drainage area of Lower Spot Pond Brook above where it discharges into the Winter Street Shaft in Malden is 6 square miles, and the channel distance to Wyoming Station is 4,750 feet (of which 3,340 feet are in Melrose).

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FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MELROSE, MA
(MIDDLESEX CO.)

APPROXIMATE SCALE

4000 0 4000 8000 12000 FEET

VICINITY MAP

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The land surrounding Lower Spot Pond Brook is primarily commercial and industrial, with medium to high density residential properties. The brook and approximately 60 feet to both sides of its center line are owned by the MDC.

Ell Pond is located north of the Melrose business district along Main Street. An outlet structure is located at its southernmost end. The land surrounding the pond is a mixture of residential, commercial, and institutional development. Low-lying areas are to the north of the pond, and high banks are found to the south and east along Emerson Street and Main Street, respectively.

The climate of Melrose is typical of eastern Massachusetts communities. Temperature averages range from 72.7 degrees Fahrenheit (°F) in summer to 28.7°F in winter. The average annual precipitation of the region is 41.4 inches, with an average recorded snowfall of 42 inches. The precipitation is fairly evenly distributed throughout the year (Reference 2).

2.3 Principal Flood Problems

Past flooding in Melrose indicates that flooding can occur during any season of the year. However, most major floods have occurred during February, March, and April and are usually the result of spring rains and/or snowmelt. Floods occurring during the midsummer and late summer are often associated with tropical storms moving up the Atlantic coast.

A number of major floods have occurred in the Lower Spot Pond Brook basin during the twentieth century. The worst floods occurred in 1936, 1955, 1962, and 1968. Since 1940, reliable records of flood flows have been kept at the USGS gaging station (No. 01102500) at Winchester, Massachusetts, on the Aberjona River.

The worst flood since the completion of channel improvements on Lower Spot Pond Brook occurred in October 1962. According to local sources, the cresting water surface in the brook came within 6 inches of overtopping the banks (Reference 3). The storm causing this flooding was Hurricane Daisy, which dropped 11 inches of rain over a period of 60 hours. The recurrence interval for the storm exceeded the 100-year level established by the USGS (Reference 4).

During Hurricane Daisy and other large storms, many areas in the Spot Pond watershed were inundated, even though Lower Spot Pond Brook did not overflow (References 3, 5, and 6). Street drains were unable to function because of the high water levels in Lower Spot Pond Brook, which prevented gravity drainage. These local drainage problems occur in low-lying areas having storm drains that discharge into Lower Spot Pond Brook and Ell Pond.

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Ell Pond does not contain floodwaters as well as Lower Spot Pond Brook. Chronic flooding of the low-lying land contiguous to Ell Pond has been a matter of public concern for over 100 years (Reference 7). The condition of flooding on Ell Pond worsened starting in the 1930s when the city began filling in portions of the pond for development purposes. Two Melrose public schools and other structures built in this area can be damaged when Ell Pond overflows.

2.4 Flood Protection Measures

A number of flood control projects have been constructed in Melrose. Spot Pond Brook Branch and Ell Pond Brook Branch were enclosed in a piecemeal manner that improved floodwater drainage. Further channel improvements were made to Lower Spot Pond Brook from the outlet of Spot Pond Brook Branch and Ell Pond Brook Branch near Wyoming Station to the Melrose-Malden border. The existing streambed was deepened, widened, and lined with concrete in 1960. A 12.5-foot diameter tunnel built at the downstream end of Lower Spot Pond Brook in Malden provided the capacity to contain a 25-year flood discharge safely within the new channel's banks. This tunnel was built to circumvent the construction of a surface drainage structure through the center of Malden, where the old stream channel ran down to its confluence with the Malden River. The tunnel outlet structure directs discharge into the Malden River near Charles Street in Malden and is the source of the Malden River flows. At the time the tunnel was constructed, the Malden River water-surface elevations were affected by tidal surge. Amelia Earhart Dam was built across the confluence of the Malden and Mystic Rivers in the early 1970s to maintain the upstream water surface at constant elevations. The dam, however, has minor influence on Lower Spot Pond Brook elevations during normal conditions. During high intensity storms of long duration, the elevation of the Malden River may affect water-surface elevations at the tunnel intake and points further upstream along Lower Spot Pond Brook.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare

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flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for the flooding sources studied in detail affecting the community.

Two USGS publications provided a standardized technique for the hydrologic analysis of Lower Spot Pond Brook (References 8 and 9). The two publications are complimentary, where a rural watershed discharge was computed and used as input for computing an urban watershed discharge. The urban discharge also depended on drainage areas but, in addition, the level of basin development (in terms of runoff channelization) influenced resulting discharges. The only portion of the Lower Spot Pond Brook watershed contributing flow through the Melrose-Malden corporate limits that is not fully developed is the area in the Fellsway Reservation. The rest of the basin has little attenuation of runoff.

A summary of drainage area-peak discharge relationships for Lower Spot Pond Brook is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
LOWER SPOT POND BROOK					
At the intake to Winter Street Shaft in Malden	6.0	640	900	1,060	1,480

Stillwater elevations for the 10-, 50-, and 100-year floods for Ell Pond were obtained from the Mystic River Comprehensive Hydrology Study (Reference 10). The 500-year flood elevation for Ell Pond was not calculated in that study. The 500-year discharge splits between the Ell Pond conduit and a broad-crested weir formed along the northeastern corner of Emerson Street and Main Street. The 500-year elevation was determined considering flow through the conduit and over the roadway.

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A summary of peak elevation-frequency relationships for Ell Pond is shown in Table 2, "Summary of Elevations."

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
ELL POND				
Entire shoreline	49.0	52.4	54.2	54.7

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the riverine source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analysis of Lower Spot Pond Brook were obtained from topographic maps compiled from aerial photographs (Reference 11). Below-water sections were obtained by field measurements. All bridges were surveyed to obtain elevation data and structural geometry.

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 12). The results were compatible with water-surface elevations observed during Hurricane Daisy in 1962 (Reference 3). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Lower Spot Pond Brook were obtained from the Flood Insurance Study for the City of Malden (Reference 13).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. The channel "n" value for Lower Spot Pond Brook was 0.024, and the overbank "n" value was 0.044.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

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4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the flooding sources studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 11).

For the flooding sources studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for Melrose and field checked for accuracy (Reference 14).

The 100- and 500-year flood plain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights.

No floodway was delineated for Lower Spot Pond Brook because the 10-, 50-, 100-, and 500-year flows for the stream are contained within the channel.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the City of Melrose.

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5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The location of the reach determined for the riverine flooding source of the City of Melrose is shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

In lacustrine areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. Using these criteria, one reach was required for the lacustrine flooding source of the City of Melrose. The location of this reach is shown on the Flood Insurance Rate Map and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100 YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Lower Spot Pond Brook							
Reach 1	03	-1.5	-0.5	+1.9	015	A3	Varies
Ell Pond							
Reach 1	01	-5.2	-1.5	+0.5	050	A10	54

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MELROSE, MA
(MIDDLESEX CO.)

FLOOD INSURANCE ZONE DATA

LOWER SPOT POND BROOK AND ELL POND

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associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zones A3 and A10: Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Melrose is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies for the City of Malden and the Town of Stoneham are currently being prepared (References 13 and 15). The results of those studies will be in exact agreement with the results of this study.

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This study is, in part, based on information provided by two published engineering reports: the Report of Flood Control in the Spot Pond Brook Watershed and the 1981 MDC study (References 7 and 10). On Ell Pond, this study is in complete agreement with results of the MDC study, which includes a special analysis of the Ell Pond area. This study is not in agreement with the Spot Pond Brook report. Flood-frequency characteristics have changed in the basin in the years since that report was published.

Due to a more detailed analysis, this study supersedes the previously published Flood Hazard Boundary Map for Melrose (Reference 14).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region I Office, J. W. McCormack Post Office and Courthouse Building, Room 462, Boston, Massachusetts 02109.

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REACH 1
ZONE A3

CORPORATE LIMITS

BRIDGE TO FACTORY

BANK PLACE

BOSTON AND MAINE RAILROAD

LIMIT OF DETAILED STUDY

CULVERT

ELEVATION IN FEET (NGVD)

50
45
40
35
30

10 15 20 25 30 35 40 45 50

STREAM DISTANCE IN HUNDREDS OF FEET ABOVE MALDEN TUNNEL HEADWORKS

LEGEND

- 500 - YEAR FLOOD
- 100 - YEAR FLOOD
- 50 - YEAR FLOOD
- 10 - YEAR FLOOD
- STREAM BED
- CROSS SECTION LOCATION

FLOOD PROFILES

LOWER SPOT POND BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MELROSE, MA

(MIDDLESEX CO.)

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